Spacecraft Disassembly

HSI_RCV_SC_Disassebly

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Paul Turin
Peter Harvey

1 Introduction

During environmental testing of HESSI, a vibration test anomaly caused severe damage to the spacecraft. The shaker delivered approximately 20G's, ten times the appropriate levels for the test. As a result, the spacecraft structure and the X-axis solar arrays were damaged. Thus, it is not known whether the HESSI spacecraft (S/C) is safe to lift in one piece.

The following procedure outlines the disassembly and removal of the spacecraft from the vibration table. The primary objectives of this are to [1] ensure nobody is harmed by having the spacecraft collapse on them; and [2] limit further damage to flight components during disassembly.

1.1 Signatures

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Peter Harvey, HESSI Project Manager

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Dr. David Pankow, HESSI Lead Mechanical Engineer

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Ron Jackson, HESSI Quality Assurance

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Frank Snow, HESSI Mission Manager

1.2 Staffing Requirements:

The following people or their delegates are expected to be in place for the procedure.

Item	Description	Name	Req'd/other
1.1.	HESSI Spacecraft Disassembly Coordinator	Peter Harvey	Required
1.2.	HESSI Spacecraft Lead Mechanical	Dave Pankow	
1.3	HESSI Imager Representative	Alex Zehnder and/or Peter Ming	Req'd for Imager Lift
1.4	HESSI Spectrometer Designer	Paul Turin	
1.5.	HESSI Quality Assurance	Ron Jackson	Required
1.6	HESSI Bus Representative	John DiPalma or John Jordan	
2.	JPL Representative / Instrumentation	Doug Perry	
3	FRB Representation	Rodney Phillips or Dan Worth	Required for S/C lift

1.3 Disassembly Requirements

Item	Requirement
1	All activities will be coordinated by the designated Disassembly Coordinator.
2	All activities will require FRB representative to be present.
3	As the blankets are removed, accelerometer locations must not be disturbed.
4	Photographs must be taken of all damage encountered.
5	If at any time, new structural damage is encountered, the Lead Mechanical engineer must assess the safety of continuing disassembly.
6	Redlines to this plan require notification to an FRB representative, and agreement by the Disassembly Coordinator and Mission QA.

2 FRB Requirements

The following measures are to be taken to insure the integrity of the accelerometers and cabling used in the control loop:

1. Move and tape the cables for the control and input monitor accelerometers closer to the test fixture without removing the piece of tape closest to the accelerometers.
2. Protect the control and input monitor accelerometers and the exposed length of associated cables using aluminum angle or padding and covered with black and yellow safety tape.
3. Secure the passageway between the control parch panel and the instrumentation patch panel.
4. Put out signs indicating that no one shall disconnect the cables to both the control panel and the instrumentation patch panel.

5. Verify the cable numbers to each accelerometer location before the accelerometer is removed.
6. Photograph each accelerometer location before the accelerometer is removed.
7. For each accelerometer, determine if it is attached and record for each location before removal.

Accel	Location	Photo	Attached	Accel	Location	Photo	Attached
1				22			
2				23			
3				24			
4				25			
5				26			
6				27			
7				28			
8				29			
9				30			
10				31			
11				32			
12				33			
13				34			
14				35			
15				36			
16				37			
17				38			
18				39			
19				40			
20				41			
21				42			

3 Pre-Disassembly

Prior to disassembly, JPL and FRB photographs will be taken to record the damage and possible help determine the cause of the anomaly. UCB, JPL and FRB representatives will inspect the spacecraft and the vibration test setup to their satisfaction.

At the current time, the spacecraft has been "safed" as follows:

- The Spectrometer Vacuum Pump is attached and operating;
- The Imager TMS test connector has been inserted;
- The PMT cover has been installed;
- The CSS covers (8) have been installed;
- The Battery Flight Plug has been removed;
- The spacecraft is unpowered.

Any other configuration comments may be noted by the Disassembly Coordinator and appended to the as-run of this procedure.

4 Disassembly Procedure

4.1 Attach Covers and Remove Harnessing

- Remove S/C to S/C GSE harness.
- Install connector covers
- Install RAS cover
- Install Fine Sun Sensor cover
- Remove Solar Array accelerometers
- Remove RAS Accelerometer

4.2 Remove Lower blankets

- Cut seam tape holding blankets on to allow removal without damage.
- Label each blanket with location per master S/C map and clean bag.

4.3 Remove Solar Arrays

- Remove -X panel in folded position.
  - Attach debris shield so nothing goes into the Spectrometer area.
  - Disconnect -X panel connectors (2).
  - Support the panel by hand using 2 people on each side of the panel.
  - Remove Lower Frangibolt.
  - Remove the Upper Frangibolt plate and Upper Frangibolt.
  - Unbolt from S/C
  - Lift away from S/C
  - Using 2 more people, unfold the array and lay flat in shipping container.
  - Remove debris shield
  - Bag Frangibolts and other bolts and mark as such.
  - Attach connector covers to S/C and to Array connectors.

- Remove +X panel in folded position (same as -X)
- Deploy and remove +Y, -Y panels.

4.4 Remove Upper blankets

- Cut seam tape holding blankets on to allow removal without damage.
- Label each blanket with location per master S/C map and clean bag.

4.5 Photography and Damage Assessment

- Photograph any damage revealed by removal of solar arrays and blankets.
- Reassess structural integrity of the bus.

4.6 Remove Instrumentation

- Verify accelerometer attachment.
  - Identify any accelerometers that broke free during test.
  - Photograph accelerometers.
- Remove accelerometers, thermocouples, and TV heaters.
  - JPL personnel will remove accelerometers, TC's, and harnessing.
  - Cut extension wires to heaters, coil the remaining heater wire, and tape to heater.

4.7 Remove Imaging Components

4.7.1 Inspect and Secure Imager

- Inspect damage to mounting ring.
- Measure distance between attachment points.
- Add clamps to stabilize fractured ring if necessary.
- Add imager lift bars.
- Lower crane and lifting fixture over imager and attach to the 3 lifting bars.
- Support Imager weight using hydraset; i.e. lift with 47 kg (103 lbm).

4.7.2 Remove Harnessing

- Demate Transmit and Receive Coaxes from the Forward RF Antennae.
- Remove RF ties
- Remove RF coaxes from the Imager and secure to S/C deck.
- Demate 6 SAS Connectors
- Demate Lower Grid Tray Connector
- Demate Upper Grid Tray Connector
- Demate FSS Connector.

4.7.3 Remove Imager Tube and Trays

- Unbolt Imager from hard-points.
- Remove broken half of Imager Support Ring.
- Remove lower Imager blankets.
- Disconnect Imager harnesses.
- Lift Imager straight up utilizing crane and Hydraset.

- Move Imager to transport Cradle.
- Install SAS lens covers.
- Remove FSS and Forward Antennas from Imager and store.
- Perform TMS in Vertical and Horizontal Positions.
- Secure and bag for transport.

4.8 Determine Bus structural integrity

- Inspect Bus for fractures, deformation, broken bolts, etc.
- Decide if Bus is safe to transport with boxes mounted.

4.9 Remove Unnecessary Masses

- If the structure is compromised, then
  - Remove Flight Battery
  - Remove Solid State Recorder
  - Remove SEM
  - Remove Transponder
  - Remove IDPU
  - Remove CPC
  - Remove IPC

4.10 Remove Vibration Fixture Bolts

- Remove "Guide" bolts (+X, -X, +Y, -Y) and record data in table 1.
- Insert alignment pins in the +X, -X, +Y and -Y positions.
- Remove the other 20 bolts and record data in table 1..

Table 1.

Bolt#	Removal Torque(in lb)	How Loose (# turns)
+X0		
+X1		
+X2		
+X3		
+X4		
+X5		
+X6		
+X7		
-X0		
-X1		
-X2		
-X3		
-X4		
-X5		
-X6		
-X7		
+Y0		
+Y1		
+Y2		
+Y3		
+Y4		
+Y5		
+Y6		
+Y7		
-Y0		
-Y1		
-Y2		
-Y3		
-Y4		
-Y5		
-Y6		
-Y7		

X0 is TDC and X1 is clockwise looking from the top.

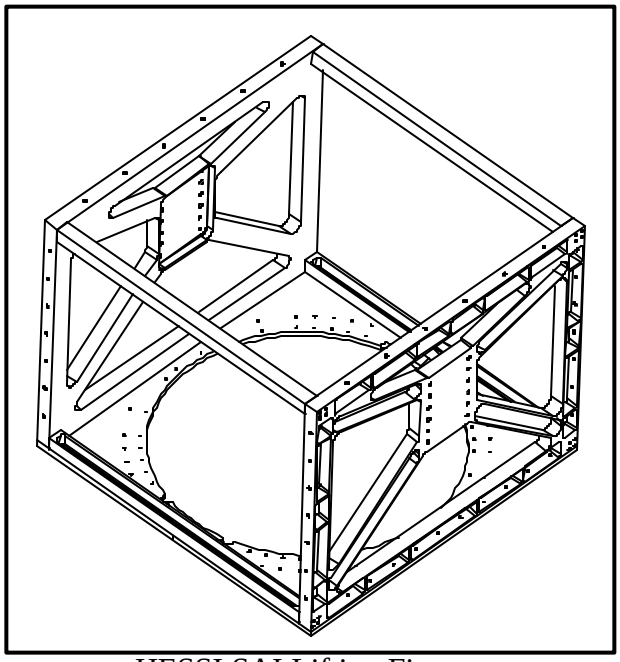
4.11 Lift

- Detach Spectrometer Pump.
- Lift Spectrometer Pump off vibration table and remount on Pump Cart Lift
- Install S/C lifting fixture to HESSI and attach to base ring.
- Lift S/C off vibration table vertically watching the 4 alignment pins.
- Move to S/C Dolly and secure.
- Remove lifting fixture
- Bolt down the force transducers with new bolts of appropriate length.

4.12 Safe Spacecraft

- Torque bolts holding S/C to dolly.
- Attach Spectrometer Pump.

Appendix A.



HESSI SAI Lifting Fixture

Table 2. Accelerometer List

Description	X axis TEST	Y axis TEST	Z axis TEST	X axis Ch.I.D.	Y axis Ch.I.D.	Z axis Ch.I.D.
*Spacecraft Base Ring 1	1(X,Y,Z)	1(X,Y,Z)	1(X,Y,Z)	1,2,3	1,2,3	1,2,3
*Spacecraft Base Ring 2	2X	2Y	2Z	4	4	4
*Spacecraft Base Ring 3	3X	3Y	3	5	5	5
*Cryostat Inboard Attach 1	4(X,Y,Z)	4(X,Y,Z)	4(X,Y,Z)	6,7,8	6,7,8	6,7,8
*Cryostat Inboard Attach 2	5X	5Y	5Z	9	9	9
*Cryostat Inboard Attach 3	6X	6Y	6Z	10	10	10
*Imager Mount 1	7(X,Y,Z)	7(X,Y,Z)	7(X,Y,Z)	11,12,13	11,12,13	11,12,13
*Imager Mount 2	8X	8Y	8Z	14	14	14
*Imager Mount 3	9X	9Y	9Z	15	15	15
*Imager Top Ring	10(X,Y)	10(X,Y)	10(X,Y)	16,17	16,17	16,17
*Imager Bottom Ring	11(X,Y)	11(X,Y)	11(X,Y)	18,19	18,19	18,19
*Fine Sun Sensor	12(X,Y,Z)	12(X,Y,Z)	12(X,Y,Z)	20,21,22	20,21,22	20,21,22
*Magnetometer	13(X,Y,Z)	13(X,Y,Z)	13(X,Y,Z)	23,24,25	23,24,25	23,24,25
*#Deck, Box Foot Quad1	14(X,Y,Z)	14(X,Y,Z)	14(X,Y,Z)	26,27,28	26,27,28	26,27,28
Deck, Box Foot Quad 2	15Z	15Z	15Z	29	29	29
Deck, Box Foot Quad 3	16Z	16Z	16Z	30	30	30
Deck, Box Foot Quad 4	17Z	17Z	17Z	31	31	31
SSR, Inboard (neg R)	18R	18R	18R	32	32	32
SEM, Outboard (pos R)	19R	19R	19R	33	33	33
Particle Detector	20Y	20Y	20Y	34	34	34
SA Wing X Upper TiNi	21X	21X	21(X,Z)	35	35	35,36
SA Wing X Lower TiNi	22X	22X	22(X,Z)	37	37	37,38
SA Wing X Lower Rt. Side	23X	23X	23X	39	39	39
SA Wing X Mid. Rt. Side	24X	24X	24X	40	40	40
SA Wing Y Upper TiNi	25Y	25Y	25Y	41	41	41
SA Wing Y Lower TiNi	26Y	26Y	26Y	42	42	42
SA Wing Y Lower Rt. Side	27Y	27Y		36	36	
SA Wing Y Mid. Rt. Side	28Y	28Y		38	38	

Notes:
1) The Asterisk indicates a tri-axial accelerometer
2) Use low mass accelerometers
3) Place accelerometer as close as possible to …
4) Place accelerometer on …
5) The "#" denotes location between SSR and IPC

4.12.1.1.1 Comments & Explanations

Columns 2,3,4 Identify the test axis & measuring locations. i.e. (X axis, 1X) means X direction during X test
Columns 5,6,7 are meant to represent data channels
Locations 1,2& 3 are intended to represent Vertical Planes that are indexed to the three Imager Hard Points